Estimating the Economic Impact of Telemedicine in a Rural Community

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One commonly discussed benefit of broadband access in rural America is the potential for telemedicine visits that allow rural residents to take advantage of urbanized medical services. While the primary benefit of telemedicine is often viewed as improved health care access, the availability of these services also offers significant economic contributions to the local community. Site visits to 24 rural hospitals of varying size over a four-state area in the Midwest provide information to develop a methodology for estimating telemedicine's economic impact. Using this technique, telemedicine services contribute between $20,000 and $1.3M annually to these local economies, with an average of $522,000.

Key Words: telemedicine, economic impact, teleradiology, telepsychiatry

Demonstrating the economic benefits associated with telemedicine is essential for the justification of community investment in telemedicine infrastructure. Although communities often must decide whether to fund telemedicine through taxes, subsidies, or other means, research to date has examined only the hospital-specific benefits of telemedicine. This study expands upon that research to document the return of telemedicine not only to hospitals, but also to their surrounding communities.

Telemedicine, or the linking of rural residents with urban health specialists, has long held the promise of dramatically improving health care in rural communities. Research has shown that the availability of telemedicine allows rural areas to offer a larger variety of health care services (Rickets 2000); improve the overall perception of health care quality (Nesbitt et al. 2005); and even help with recruitment and retention of physicians (Sargeant, Allen, and Langille 2004, Goetz and Debertin 1996).

The nature of telemedicine, however, allows it to do more than simply offer better health services to a community. The economy of a rural community is impacted by the very presence of telemedicine: reduced travel lowers transportation costs and decreases missed time from work; the amount of lab and pharmacy work performed locally increases; and hospitals save from outsourcing telemedicine procedures versus having to pay an in-house specialist for the same work. Quantifying the economic impact at the community level can be important for areas considering implementing or expanding a telemedicine program, particularly since the basic rationale for the existence of such a program is to provide better service to the community. The current framework for telemedicine evaluation, done at the hospital level, does not allow for this wider view of the potential impacts.

Most of the recent empirical studies on telemedicine have used hospital-level cost analysis frameworks to determine whether or not a particular system was cost-effective (Whitten, Kingsley, and Grigsby 2000). In general, the findings have been somewhat disappointing for telemedicine, as expected cost savings have not been documented. De la Torre, Hernandez-Rodriguez, and Garcia (2004) find that, from a patient's perspective, some instances of telemedicine may not be cost-effective when compared to conventional care. Whitten et al. (2002) systematically reviewed over 600 articles that dealt with cost-benefit analysis pertaining to telemedicine and concluded that no solid evidence existed that telemedicine is a cost-effective method for the delivery of health care.

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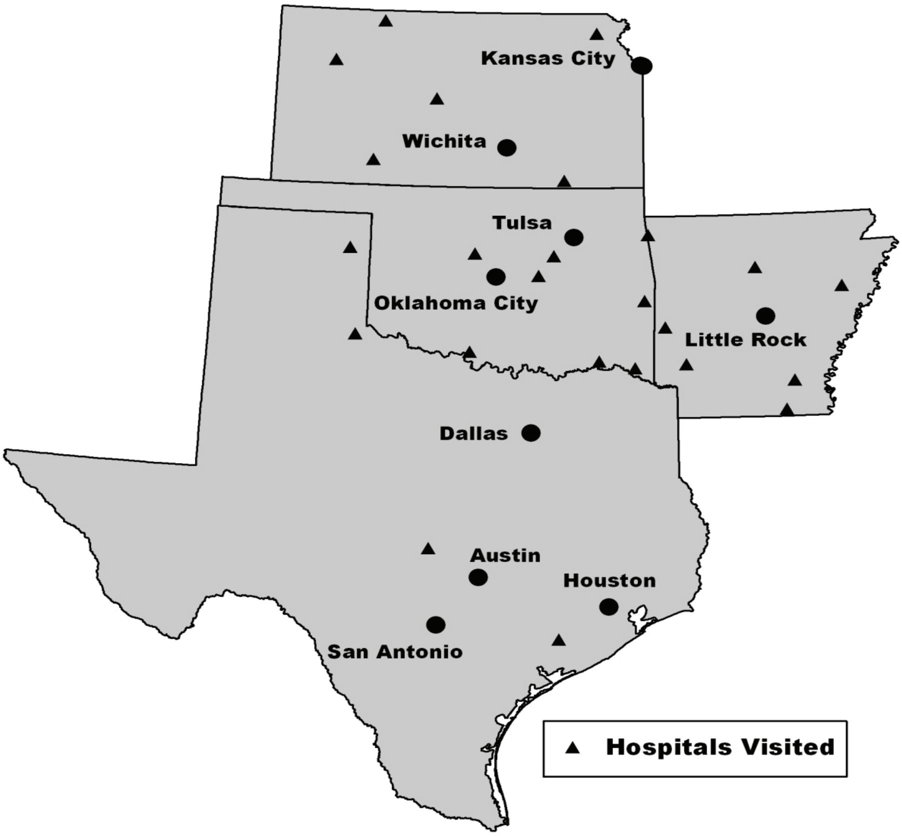

Figure 1. Locations of Hospitals in Study

However, very few (if any) studies have focused on the economic benefits of telemedicine from a *community* perspective. Only Whitacre et al. (2009) developed a framework to look at telemedicine from this viewpoint, although their study was limited to five hospitals within a single state. This paper builds upon (and adds significant detail to) the framework developed by Whitacre et al. and extends the analysis to multiple telemedicine modalities for 24 hospitals in four relatively rural states. A solid understanding of the economic potential of various forms of telemedicine is vital for communities considering implementation of such a program, particularly in light of the unstable financial environment faced by rural hospitals (Stensland, Moscovice, and Christianson 2002). Being able to document the economic impact of a particular telemedicine service could prove to be very beneficial for hospitals seeking approval for city or county sales tax funding, which is typically the case in most rural communities.

Data and Methodology

Study Area

The study area consisted of 24 rural communities in a four-state area in the Midwest (Kansas, Oklahoma, Arkansas, and Texas) as displayed in Figure 1. All of these communities have hospitals that are currently using some form of telemedicine. Sites were selected based on geographic location (variation across each state was desired) and phone calls to the sites were initiated, inquiring about telemedicine use. Telemedicine practitioners were identified (if they existed) through conversations about their experiences with telemedicine in the hospital. Such "selected" site visits have historically been used for studying telemedicine, since a random sample is not feasible due to the possibility of nonuse (Dossetor et. al 2002, Ace and Hayes 1995, Savard et al. 2003). On-site interviews at these 24 sites provided information about their telemedicine programs, including the types of services offered, the number of annual encounters, and the type of equipment used. A large segment of the sites offered only teleradiology services, in which a digital image such as an X-ray is processed in the rural location and then forwarded to an urban area where it is read by a radiologist (thus preventing the need for the radiologist to travel). Several other sites used two-way interactive television (IATV) forms of telemedicine, such as telepsychiatry or teleoncology. In this scenario, a rural patient interacts in real time over a secure Internet connection with an urban specialist. While these distinct forms of telemedicine are different in terms of associated revenue and potential for direct digital interaction, they are some of the most common types used by rural hospitals (Hassol et al. 1997, Smith et al. 2005).

Data Collection

Data from the 24 rural hospitals (Table 1) were used to develop the methodology detailed below. Typically, 2-3 hospital employees most familiar with the telemedicine procedures were interviewed on-site, with a walk-through of how the various pieces of equipment worked, over a period of 1-2 hours. Respondents included nurses who used telemedicine equipment on a daily basis, IT personnel, and in some cases hospital administrators. The hospitals ranged in size from 15 beds to 90 beds (significantly lower than the 300-plus bed hospitals common in urban locations) and were located in communities with populations ranging from 700 to nearly 11,000. On-site visits to these hospitals and interviews with hospital personnel and community leaders provided additional insight into how telemedicine is implemented, the number of annual encounters typically performed, and how telemedicine's presence might affect the local economy. This included discussions about the hospital's payroll, impacts to patients utilizing telemedicine services, and about how other local businesses might benefit from patients staying nearby to have these services performed.

Research Methodology

The typical methodology for estimating the economic impact of an industry in a rural community would be to calculate employment and income multipliers based on the number and type of jobs in that industry. However, the case of telemedicine is relatively unique in that additional employees are very rarely added to rural hospitals to perform telemedicine procedures. Rather, the additional work created by implementing telemedicine is usually assimilated into the daily work of other hospital employees. For example, site visits revealed that part of a nursing assistant's daily workload includes scanning in X-rays. These employees had no telemedicine-oriented work before the equipment was brought in but were given relatively short and simple tasks in lieu of hiring additional workers specifically to work the telemedicine equipment. Similarly, the local director of nursing typically sits in during patient telepsychiatry sessions and then writes up a prescription for the patient based on the remote physician's recommendation. Because there are no distinct "telemedicine only" jobs created in the local hospital, no basis exists to calculate income or employment multipliers for this industry.

Rather than use a multiplier-oriented methodology, this study draws from the methodology initially outlined in Whitacre et al. (2009), which in turn used previous studies and the economic literature to develop a framework for estimating the economic impact of a telemedicine center in a rural community. Ultimately, the decision to implement telemedicine can be modeled via a random utility framework, where an alternative is chosen if its associated benefits outweigh the costs. This methodology is typically well accepted for modeling rural health care alternatives (Capalbo and Heggem 1999, Bockstael 1999). However, empirically estimating a community's utility is beyond the scope of this paper, as it requires a sample size much larger than the one available here. The focus is instead on quantifying some of the costs and benefits associated with telemedicine. Further, this paper places an emphasis on the economic impact to the *community*, which may be overlooked since the implementation de-

Table 1. Rural Hospital Characteristics and Telemedicine Data

City	State	Number of Beds	Community Population	Telemedicine Modality	Annual Encounters
Siloam Springs	AR	73	10,843	Radiology	25,000
Clinton	AR	25	2,283	Radiology	14,400
Wynne	AR	15	8,615	Radiology	13,200
Crossett	AR	46	6,097	Radiology	13,200
Monticello	AR	50	9,146	Radiology	19,200
Nashville	AR	25	4,878	Radiology	13,800
Mena	AR	65	5,637	Radiology	22,200
Horton	KS	35	1,967	Oncology/Psychiatric	180
Sedan	KS	25	1,342	Psychiatric	132
Minneola	KS	15	717	Radiology	912
Hoisington	KS	25	2,975	Radiology	9,600
Norton	KS	25	3,012	Radiology	2,400
Oakley	KS	21	2,173	Radiology	3,600
Llano	TX	30	3,325	Radiology	6,000
El Campo	TX	49	10,945	Radiology	600
Childress	TX	60	6,778	Radiology	16,425
Canadian	TX	26	2,233	Radiology	2,400
Bristow	OK	30	4,325	Radiology	6,600
Hugo	OK	34	5,536	Radiology	9,600
Waurika	OK	36	1,988	Radiology/Psychiatric	1,836
Prague	OK	25	2,138	Radiology	4,500
Poteau	OK	84	7,939	Radiology	27,600
Idabel	OK	90	6,952	Psychiatric	1,500
Kingfisher	OK	25	4,380	Radiology	12,320

Source: Community population from U.S. Census Bureau (2000 Census); discussions with hospital personnel.

cision is typically performed at the *hospital* level. Following this framework, four distinct categories are used to estimate the economic impact of a telemedicine center in a rural community. Three of these categories deal with the "opportunity costs" that telemedicine presents (i.e., the costs that telemedicine helps to avoid), while the last category focuses on supplementary work that the presence of telemedicine may bring into a community. The four categories are:

(1) Hospital cost savings from outsourcing telemedicine procedures;
(2) Transportation savings to center patients;
(3) Missed work income savings to center patients;
(4) Lab/pharmacy work performed locally.

Results

Hospital Cost Savings from Outsourcing

If telemedicine were not available, rural hospitals would have to pay at least a portion of the salaries of individual specialists such as radiologists, psychiatrists, or oncologists to provide those services onsite. These specialists typically command large salaries that rural hospitals struggle to pay—or when they can pay, it is only for part-time (1-3 days per week) service. In fact, several of the rural hospitals visited for this study indicated that they had initially lost their radiologist because they were unable to pay for those services.

An individual physician is able to be more productive by remaining in a single location and

Table 2. Example of Hospital Cost Savings from Telemedicine

	Before Telemedicine				After Telemedicine			
Hospital	Job	Annual Encounters	% FTE	Hospital Pays:	Rate per Encounter	% FTE On-site	Hospital Pays:	Annual Savings:
A	Radiologist	6,000	1.0	$202,000	$10	0.2	$100,400	$101,600
B	Radiologist	2,800	0.4	$80,800	$10	0	$28,000	$61,600
	Psychiatrist	360	0.4	$52,000	$120	0	$43,200	

FTE is full-time-equivalent physicians, 0.2 FTE represents approximately 2 days per week.
Sources: Physician Compensation and Production Survey, discussion with on-site radiologists and radiology directors.

constantly working with patients instead of spending a large portion of their day traveling (Bulik 2004). A group of physicians specializing in a particular modality (such as radiology or oncology) in a more urban area can then market themselves to several rural hospitals and serve a larger number of patients, which supports the idea that telemedicine increases efficiency. The potential annual cost savings from using telemedicine for a rural hospital in this particular category is based on how the personnel situation has changed since telemedicine was implemented, and how much the outsourced visits cost.

Table 2 provides two examples of cost savings that would result if radiology and psychiatry consultations were converted to telemedicine and the number of procedures performed remained the same. In this example, hospital A was able to reduce their radiologist hours from one full-time equivalent (1.0 FTE) to a 0.2 FTE (roughly 1 day per week) by using telemedicine. Similarly, hospital B used telemedicine to completely remove the need for a radiologist and psychiatrist, both of which had been visiting on a part-time basis. Personnel at each hospital provided insight into the pre-/post-telemedicine employment situations. These situations varied widely, from completely eliminating a full-time physician spot to keeping a 0.2 FTE even after telemedicine was implemented. Data for rural specialist salaries comes from the Physician Compensation and Production Survey (Medical Group Management Association 2000).

The data on costs per telemedicine encounter shown in Table 2 represent an average paid by the 24 rural hospitals in the study. It should be noted that there was a wide amount of variation in this number, including some hospitals that do not pay any fee at all, instead letting the radiologist handle their own billing. While the patient does have a cost in this case, it is typically similar to what is paid to the hospital under more traditional on-site service. Although it appears that this revenue has left the community (since it is being paid to a remote site as opposed to the local hospital), the vast majority of physicians who actually end up with the payment made to the hospital are *not* based locally. This idea of "leakage" is further discussed in the conclusion section of this paper. It should be noted that some hospitals that do pay a fee for telemedicine services make monthly payments, which are not always prorated based on the number of encounters performed.

Transportation Savings

Hospital personnel were quick to cite the ability to obtain quick turnaround time for their patients (who never had to leave the community) when discussing telemedicine benefits. Residents who take advantage of telemedicine procedures available at their local hospital do not pay out of their own pocket to travel to the nearest alternative location. These transportation savings have been noted in several studies (Maass, Kosonen, and Kormano 2000, James and Folen 1999). At the community level, this can accrue to a significant amount of money. Factors impacting the amount of savings that occur include the driving distance to the nearest location that would offer the same level of service, an average cost per driven mile, and the percentage of telemedicine encounters that would necessitate an immediate response.

Table 3. Transportation Savings due to Telemedicine

Site	One-Way Miles to Nearest Site	Total Travel Miles	Mileage cost per trip	Total Number of Encounters per Year	% Needing Service	Total Cost Savings
Siloam Springs	18	36	$18.18	25,000	5%	$22,725
Clinton	80	160	$80.80	14,400	5%	$58,176
Wynne	50	100	$50.50	13,200	5%	$33,330
Crossett	53	106	$53.53	13,200	5%	$35,330
Monticello	50	100	$50.50	19,200	5%	$48,480
Nashville	50	100	$50.50	13,800	5%	$34,845
Mena	80	160	$80.80	22,200	5%	$89,688
Horton	73	146	$73.73	180	100%	$13,271
Sedan	95	190	$95.95	132	100%	$12,665
Minneola	130	260	$131.30	912	5%	$5,987
Hoisington	56	112	$56.56	9,600	5%	$27,149
Norton	97	194	$97.97	2,400	5%	$11,756
Oakley	88	176	$88.88	3,600	5%	$15,998
Llano	75	150	$75.75	6,000	5%	$22,725
El Campo	76	152	$76.76	600	5%	$2,303
Childress	115	230	$116.15	16,425	5%	$95,388
Canadian	105	210	$106.05	2,400	5%	$12,726
Bristow	30	60	$30.30	6,600	5%	$9,999
Hugo	53	106	$53.53	9,600	5%	$25,694
Waurika	54	108	$54.54	1,836	Varies	$9,981
Prague	55	110	$55.55	4,500	5%	$12,499
Poteau	31	62	$31.31	27,600	5%	$43,208
Idabel	72	144	$72.72	1,500	100%	$109,080
Kingfisher	50	100	$50.50	12,320	5%	$31,108

Note: $0.505 per mile travel cost assumed (2008 IRS rate). Google Maps© used to estimate distance.

This last factor accounts for the idea that not all telemedicine encounters require immediate feedback. For example, some rural hospitals still have radiologists who make weekly visits. In the absence of telemedicine, local patients getting an X-ray over the weekend for a minor incident such as a broken finger might have to wait until the end of the following week to get their X-ray read. In these cases, no travel would be performed by the patient regardless of whether or not telemedicine was available, and hence no telemedicine savings could be claimed. However, in more serious cases, the patient would either be taken to a facility where the X-ray could be performed and interpreted right away, or the film itself would be couriered for interpretation. These cases are the ones where telemedicine travel savings occur.

Table 3 presents travel cost savings estimates for the participating telemedicine sites. Distance to the nearest location that can perform the same work on-site is noted, based on conversations with hospital personnel. This information is used to estimate the total travel miles to and from that site (estimated by map distance using an online data source such as Google Maps©). A mileage cost per trip is then estimated, based on the official Internal Revenue Service mileage rate for 2008 of $0.505 per mile. This cost per trip is then applied to the total number of encounters that would require travel, which is based on the percentage of encounters requiring immediate assistance. Discussion with radiology experts at several rural hospitals indicated that approximately 5 percent of all radiology encounters are serious enough to warrant this type of immediate attention. Telepsychiatry and teleoncology sites, without an available option to "wait for the doctor," have 100 percent of encounters that qualify for

Table 4. Missed Work Income Savings due to Telemedicine

Site	Average Hourly Wage	One-Way Miles to Nearest Site	Travel Time Saved (minutes)	Cost Saved per Trip	Number of Potential Trips per Year	% Needing Service	Total Savings
Siloam Springs	$19.11	18	76	$24.20	25,000	5%	$30,253
Clinton	$11.92	80	150	$29.81	14,400	5%	$21,463
Wynne	$12.96	50	180	$38.87	13,200	5%	$25,651
Crossett	$17.25	53	154	$44.28	13,200	5%	$29,227
Monticello	$12.26	50	160	$32.70	19,200	5%	$31,396
Nashville	$12.98	50	144	$31.14	13,800	5%	$21,490
Mena	$11.28	80	226	$42.49	22,200	5%	$47,168
Horton	$12.77	73	202	$43.01	180	100%	$7,741
Sedan	$10.28	95	218	$37.36	132	100%	$4,931
Minneola	$14.25	130	280	$66.49	912	5%	$3,032
Hoisington	$14.44	56	124	$29.84	9,600	5%	$14,322
Norton	$12.24	97	216	$44.06	2,400	5%	$5,288
Oakley	$11.60	88	170	$32.87	3,600	5%	$5,916
Llano	$14.20	75	172	$40.71	6,000	5%	$12,212
El Campo	$14.37	76	168	$40.23	600	5%	$1,207
Childress	$12.13	115	250	$50.56	16,425	5%	$41,519
Canadian	$17.85	105	232	$69.02	2,400	5%	$8,282
Bristow	$15.23	30	50	$12.69	6,600	5%	$4,188
Hugo	$11.73	53	128	$25.03	9,600	5%	$12,016
Waurika	$10.85	54	142	$25.67	1,836	Varies	$25,986
Prague	$12.80	55	122	$26.03	4,500	5%	$5,856
Poteau	$12.51	31	96	$20.02	27,600	5%	$27,629
Idabel	$14.68	72	186	$45.51	1,500	100%	$68,269
Kingfisher	$15.60	50	120	$31.20	12,320	5%	$19,216

Source: Google Maps©, 2006 Bureau of Economic Analysis Wages by County.

telemedicine cost savings under this transportation category.

Missed Work Income Savings

When a rural patient has to travel to obtain health services, they not only have to pay for the cost of that travel (as detailed in Table 3), but they are also absent from work during their travels and forfeit any work income during that time. The methodology for estimating this missed work income is very similar to that for travel cost savings, but instead of driving distance and a per-mile cost, total driving time and an average hourly wage are used. To simplify the calculations, only actual round-trip travel time is included in this estimate since the time to perform a procedure should not vary significantly between hospitals. However, it should be noted that some additional travel time may occur due to paperwork requirements for a first-time hospital visitor, and thus the missed work savings are likely underestimated.

Table 4 again displays the teleradiology sites and telepsychiatry/teleoncology sites along with their nearest substitute location and distance from that site in miles. To estimate the total work savings, an average hourly wage was obtained for the county in which the telemedicine site resides using 2006 U.S. Bureau of Economic Analysis (BEA) data. This hourly wage was then multiplied by the total number of hours spent traveling (again estimated by any readily available online

Table 5. Local Lab/Pharmacy Work due to Telemedicine

			Monthly Cost per Prescription		Yearly Costs (assuming 3 mo.)	
Telepsychiatry	Number of Yearly Encounters	% of Patients Using	Low	High	Low	High
Aderall	84	50%	$85	$350	$10,710	$44,100
Xanax	84	20%	$60	$300	$3,024	$15,120
Teleradiology	Number of Yearly Encounters	% of Patients Using	Test Costs		Yearly Costs	
Blood Work	2,400	10%	$100	$1,200	$24,000	$288,000
MRI	2,400	2%	$400	$4,000	$19,200	$192,000
CT Scan	2,400	5%	$400	$2,000	$48,000	$240,000
Biopsy	2,400	2%	$300	$1,200	$14,400	$57,600
	Number of Yearly Encounters	% of Patients Using	Monthly Cost		Yearly Costs	
Pain Medicine	2,400	30%	$50	$300	$36,000	$216,000

mapping service) to derive a cost savings per trip. As with Table 3, the number of trips per year and the percentage requiring immediate service are also included to provide a fair comparison.

Lab/Pharmacy Work Performed Locally

While the cost categories discussed above are certainly valid for demonstrating the benefits of telemedicine, they all represent *savings* that do not explicitly find their way into the pockets of local businesses or community members. On the other hand, an increase in lab or pharmacy work performed locally is a financial impact that is felt directly by the local economy. Eilrich, Doeksen, and St. Clair (2007) indicate that the site of a patient's initial screening is a primary determinant of where they will have their lab or pharmacy work performed. Other studies have also suggested that telemedicine leads to a reduction in the amount of local business lost in a community (Nesbitt et al. 2000, Hilty et al. 2004). Because telemedicine patients do not leave their local area to receive their original diagnosis, any resulting follow-up work is more likely to end up at the local pharmacy or lab. The level of this increased income can be significant.

To estimate this impact, typical follow-up procedures and medications resulting from psychiatric and radiology visits are listed in Table 5, based on discussions with site physicians. Site physicians and assistants also provided estimates of the percentage of patients requiring these follow-ups. Low and high cost estimates for the tests and prescriptions required are gathered based on publicly available price lists. This information is converted into an annual cost, based on an assumed number of annual encounters (for Table 5, this is assumed to be 84 psychiatric visits and 2,400 teleradiology reads), which will vary by hospital facility. One inherent assumption is that *no* additional work would have been performed locally in the absence of telemedicine.

The serious nature of the follow-up tests for teleradiology indicates that most individuals would not wait to return to their local community to have them performed. Further, these tests are most often required from X-rays of "severe" patients, who would have been sent to the nearest interpretation facility as opposed to waiting for a weekly radiologist visit. This assumption can easily be altered by lowering or raising the percentage of patients using follow-up work to account for community preferences about where they have their lab/pharmacy work performed. No costs for oncology are displayed in Table 5, given the wide variation in drugs used for cancer treatment and their associated costs. However, the total accrued cost for these drugs can be significant.

While the data above show the importance of teleradiology and telepsychiatry/teleoncology visits, other forms of telemedicine such as telepodiatry and telecardiology have the potential to generate even larger revenue streams for the local pharmacy or lab, due to the higher likelihood of lab or pharmacy work in these more specialized fields.

Discussion

The four categories of impacts discussed above will vary based on the community where telemedicine is employed. In particular, the number of encounters, cost per encounter, distance to the nearest substitute location, and average wage rate will be different for various rural communities interested in telemedicine. Similarly, the pre-/post-telemedicine employment situation varies greatly, as some hospitals no longer have visiting physicians for a particular specialty, while others still have full-time employees. Each of the four categories is applied to the 24 distinct rural hospitals in Table 6 to summarize the impacts discussed above and to illustrate the importance of community differences. It is worth noting that the pharmacy/lab totals used here are the *low-end* estimates discussed in the methodology above. These are calculated by using the annual encounters for the community in question and multiplying by the percentage of patients using a specific treatment and the low-end treatment costs associated with that treatment. Thus, actual annual impacts could be significantly larger than those shown here.

In general, each community recognizes an impact of at least $20,000 per year in savings or other economic opportunities generated by the telemedicine equipment. The average annual impact is around $522,000 and the maximum impact is over $1,300,000. Most communities tend to obtain the majority of their savings from increased lab/pharmacy revenues, due to additional work now performed locally, which is heavily influenced by the number of annual encounters. It is interesting to note that for some hospitals, the impact of telemedicine is actually negative for personnel costs. This implies that the physician situation did not dramatically change after telemedicine use began, and now the hospital is paying an additional fee for external reads. In some cases the personnel savings can be significant, but the savings from missed work and transportation costs rarely add up to more than 20 percent of the total impact. While these results are similar to those obtained in the smaller-scale study performed in Whitacre et al. (2009), the wide variation across hospitals suggests that different geographies and telemedicine specialties offered can dramatically impact the results. Results of the larger-scale sample from the current analysis also imply that even across different states and modalities, the largest category typically impacted is in increased local pharmacy or lab work. This may be of particular interest to rural pharmacies, which are currently struggling financially (Casey, Klingner, and Moscovice 2008).

Note that the above figures are relevant only for hospitals that no longer have a full-time radiologist or psychiatrist. For communities debating between keeping their current physicians and converting to telemedicine, *only* the personnel costs are applicable to the economic impact. If the hospital had a full-time radiologist or psychiatrist, most of the financial impact of the three remaining categories (missed work, travel time, and pharmacy/lab) would still be retained. For most rural communities, however, keeping a full-time radiologist or psychiatrist on staff is not feasible, and the total economic impact of telemedicine can be viewed as the sum of the four categories. Further, the associated "leakage" (where expenditures leave a rural area and thus reduce the economic multiplier) is very similar regardless of whether telemedicine or a rotating physician is used. In the case of a full-time radiologist or psychiatrist, however, the physician will likely spend a significant portion of their income in the rural community and may thus enhance the multiplier effect. A rotating physician would likely only spend a very minor part of his or her income in the community and would provide only a small increase in multiplier activity when compared to a fully implemented (no physician) telemedicine arrangement. These caveats should be taken into consideration when estimating the total economic impact of a telemedicine system.

Although the small sample size of this study precludes any significance testing, the underlying anecdotal numbers are helpful in exploring alternative means to economically evaluate different

Table 6. Summary of Telemedicine Economic Impacts

Site	State	Number of Beds	Community Population	Annual Encounters	Annual Cost Savings/Economic Opportunities: Personnel Savings	Transportation Savings	Missed Work	Pharmacy/ Lab	Annual Totals
Siloam Springs	AR	73	10,843	25,000	$141,400	$22,725	$30,253	$1,100,000	$1,294,378
Clinton	AR	25	2,283	14,400	$161,600	$58,176	$21,463	$633,600	$874,839
Wynne	AR	15	8,615	13,200	($36,400)	$33,330	$25,651	$580,800	$603,381
Crossett	AR	46	6,097	13,200	$129,280	$35,330	$29,227	$580,800	$774,637
Monticello	AR	50	9,146	19,200	$161,600	$48,480	$31,396	$844,800	$1,086,276
Nashville	AR	25	4,878	13,800	($8,720)	$34,845	$21,490	$607,200	$654,815
Mena	AR	65	5,637	22,200	$0	$89,688	$47,168	$976,800	$1,113,656
Horton	KS	35	1,967	180	$18,800	$13,271	$7,741	$35,280	$75,093
Sedan	KS	25	1,342	132	$24,560	$12,665	$4,931	$25,872	$68,029
Minneola	KS	15	717	912	($9,120)	$5,987	$3,032	$40,128	$40,027
Hoisington	KS	25	2,975	9,600	$9,000	$27,149	$14,322	$422,400	$472,871
Norton	KS	25	3,012	2,400	$101,000	$11,756	$5,288	$105,600	$223,644
Oakley	KS	21	2,173	3,600	$47,000	$15,998	$5,916	$158,400	$227,314
Llano	TX	30	3,325	6,000	($9,200)	$22,725	$12,212	$264,000	$289,737
El Campo	TX	49	10,945	600	($6,000)	$2,303	$1,207	$26,400	$23,910
Childress	TX	60	6,778	16,425	$37,750	$95,388	$41,519	$722,700	$897,358
Canadian	TX	26	2,233	2,400	$77,000	$12,726	$8,282	$105,600	$203,608
Bristow	OK	30	4,325	6,600	$79,440	$9,999	$4,188	$290,400	$384,027
Hugo	OK	34	5,536	9,600	$5,000	$25,694	$12,016	$422,400	$465,111
Waurika	OK	36	1,988	1,836	$11,480	$9,981	$25,986	$95,376	$142,823
Prague	OK	25	2,138	4,500	$35,800	$12,499	$5,856	$198,000	$252,155
Poteau	OK	84	7,939	27,600	$23,600	$43,208	$27,629	$1,214,400	$1,308,837
Idabel	OK	90	6,952	1,500	($34,600)	$109,080	$68,269	$294,000	$436,749
Kingfisher	OK	25	4,380	12,320	$38,400	$31,108	$19,216	$542,080	$630,804

forms of telemedicine. While this study paints a clearer picture of the impact that active telemedicine services can have on a rural economy, it does *not* imply that implementing telemedicine is a smart decision for all rural hospitals. A number of other factors, including equipment costs, reimbursement issues, licensure requirements, and practitioner/patient acceptance should be considered before such a decision is made. In particular, the reliance on grant funding to initiate telemedicine networks has been noted in several studies, in addition to the increased likelihood of failure once grant funds are exhausted (Grigsby and Getz 2004, Grigsby and Grigsby 2001). The significant costs associated with telemedicine equipment (for example: $7,000–$30,000 for a digital scanner; $20,000–$250,000 for digital radiography equipment such as CT or MRI machines; and $15,000–$20,000 for a videoconferencing suite) imply that hospitals should run cost-analysis scenarios to ensure that they are able not only to purchase but to maintain the telemedicine equipment once it becomes active. Additionally, they should make certain that the telemedicine network requirements would not be overwhelming either financially or in terms of bandwidth.

While patient acceptance of telemedicine has been high (Gutske et al. 2006, Hilty et al. 2007), its adoption rate is likely to be slow without physicians willing to bring patients in (Hilty et al. 2007, Hu et al. 1999). Public and private reimbursement remains a concern as well, with a recent survey revealing that very few state Medicaid offices reimburse for telepsychiatry or other real-time encounters with physicians (Center for Telemedicine Law 2003). Further, only 57 percent of active telemedicine programs receive payments from a private provider (Whitten and Buis 2006), suggesting that obtaining reimbursement from private payers is not automatic.

In general, rural hospitals and communities should consider how the factors mentioned above pertain to their particular scenario—i.e., local doctor support, state Medicare/Medicaid policy, and dominant local private provider policy—before assuming that a telemedicine system will generate a specific dollar amount for the local economy. However, they should also note that the benefits of telemedicine disperse to the entire community, and as such the decision—which typically takes place at the hospital level—should take into account the potential community-wide impacts.

This study demonstrates the economic importance of several particular telemedicine services (teleradiology, telepsychiatry, and teleoncology) in a rural setting. This methodology could be used in future research to find hospitals that would theoretically prosper the most from these services and compare that to existing locations. Discrepancies between actual and predicted venues would likely lead to interesting observations about how such decisions are made. Additionally, surveying actual telemedicine users and quantifying true savings and spending would be an interesting way to validate or reject the methodology presented here. Further research could also seek to quantify the impacts of policy variables, such as state Medicare/Medicaid policy and private provider reimbursement, on telemedicine adoption and utilization in rural locations. Given the dramatic economic impact that telemedicine can provide, determining the underlying implementation obstacles remains an important policy question.

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